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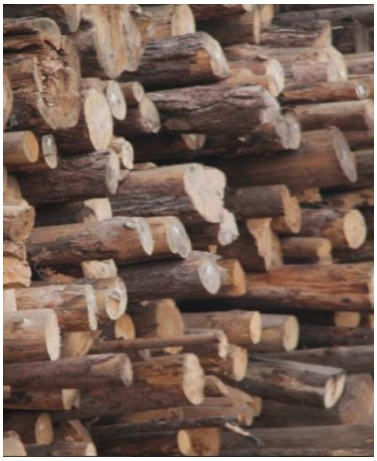
Elaboration and Analysis of Wood Processing Industry Residuals in Zlatibor region


MRS. BRANKA MITROVIĆ

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND MEASURES

DHC = District Heating Center
m³ = cubic meters
rm³ = raum (spatial) cubic meters
m³ /a = cubic meters per annum
RSD = Serbian dinars
ha = hectares
km = kilometers
t = tons
t/a = tons per annum

Summary of main research findings

Zlatibor region occupies South-Western mountainous part of Serbia. City of Uǵice and 6 other municipalities (Bajina Baģta, Ļajetina, Arilje, Priboj, Prijepolje and Nova Varoģ) have been at the focus of this research. The objective of the assignment was to identify wood processing facilities in those 7 designated municipalities and respective availability of wood residuals for fueling planned local biomass District Heating Centers (DHCs).

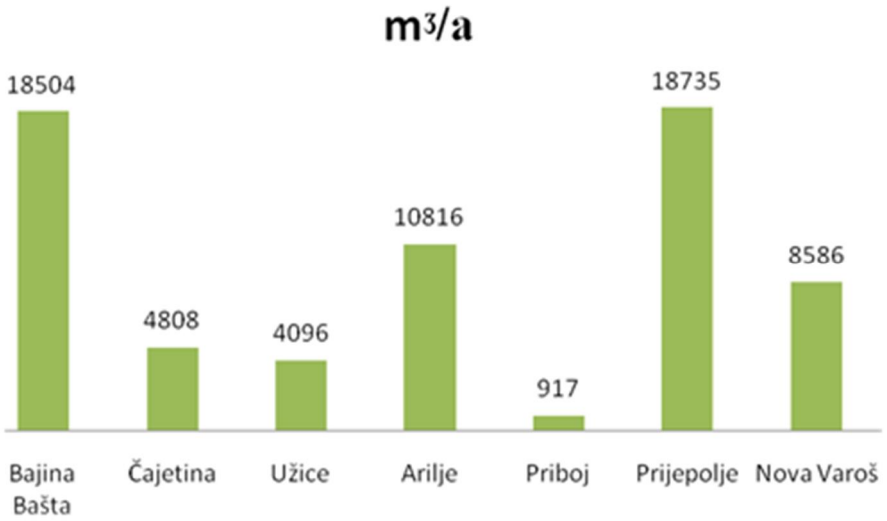
In total 94 wood processors have been identified and included in the research, with number of unregistered small sawmills taken into account. Those who have closed their plants were also considered as indication of the consolidation process in wood processing industry that is going on in the region and in Serbia as the whole. In addition, Serbian law allows small entrepreneurs to temporarily close their businesses, up to one year. A number of small seasonal family-owned sawmills are not easy to track. From the point of view of number of wood processors as well as the collected data showing total volume of processed wood and produced wood residuals ï Bajina Baģta and Prijepolje are clearly two main concentration points for the wood processing industry. Bajina Baģta is the one single municipality with the highest biomass potential, included forested areas and their annual increment (wood mass growth on annual basis). Arilje and Nova Varoģ are also distinguished, with other 3 municipalities behind. This distribution of the biomass potential and wood industry is also translated in the produced quantities of wood residuals. Figure shows the quantities of produced wood residuals per municipality.

Bajina Baģta and Prijepolje are situated in the northern and southern tips of the region. The wood processing industry has been, in recent years, advancing the most in the Prijepolje, Priboj and Nova Varoģ municipalities. Prijepolje has the most advanced transportation fleet in the region.

Over the researched period, the prices of wood residuals have been growing nominally, expressed in RSD. However, the prices converted in ú have remained rather stable. It is to be expected that prices will follow the increasing trend over the next years because of the development of mini pellet and briquette production facilities, as well as the expected

finalization of wood biomass based district heating centers, with projects on-going in Bajina Baġta, Nova Varoġ and Priboj.

Figure 1: Produced average quantity of wood residuals (rm³/a) per municipality 2013-2015



Note: raum meters

Research showed that the transportation fleet exists within wood processing companies and that transportation of wood residuals from wood processing plants to the consumers (wood pellet, briquettes, panel and other producers) can be conducted from the supply side, delivering residuals to the final customers` yards.

Total Raw material input in the studied area has been 233.392 m_{ob} and total quantity of produced wood residuals 66.462 rm_{ob} According to our estimate based on the consistent information we got from conversations, there are approximately 20% more wood residuals produced, which are not registered in the books. Residuals remaining in the forest have not been taken into account. Taking into account legal requirements for substantial part of the residuals to remain in the forest, current forest exploitation practices, configuration of terrain and the level of development of the forest infrastructure in the area; we estimate that between 25.000 and 30.000 rm_{ob}/a of residuals could be collected in the forests. Adding up all the sources ï wood processing industry, including unregistered and seasonal processing as well as accessible and surplus forest residuals, we estimate that there is on total 107.254 $rm_{ob}$of wood residuals available in the region ï see Table 1.

Table 1: Annual average available wood residuals in studied 7 municipalities in Zlatiborski region

Wood Residual Availability	rm3
Wood processors Production	66.462
Unregistered production estimate (20%)	13.292
Accessible forest residuals estimate app.	27.500
TOTAL	107.254

It is important to note that the supply side ï production of wood residuals was researched. Therefore, wood processing companies that only consume wood residuals (demand side) such as wood pellet plants were not taken into account, as their processing of wood residuals ï consumption cannot be added to the production part. Similarly, with companies that bought produce wood residuals themselves, but who also buy up residuals from other companies throughout the region (such as ñStar Jelaò from Prijepolje), only the part they produce (supply) themselves was taken into account in order to avoid duplication.

Much of the wood from the region is being sold to other regions or abroad (e.g. to ñKronospan Serbiaò in Lapovo). However, researched companies are also engaged in importing wood from Bosnia and Herzegovina, Montenegro and Kosovo (e.g. ñStar Jelaò from Prijepolje).

Based on the geographic characteristics of the region, as well as on the existing wood processing industry and the way forestry administration is set-up in Serbia; for the purpose of this research we can identified two different areas:

- Northern part, with wood processing plants concentrated around National Park ñTaraò and this area is north of Zlatibor Municipalities of Bajina Baġta, Ļajetina, Arilje and City of Uġice belong here.
- Southern Part, along the border with Montenegro and south of Zlatibor, including municipalities of Prijepolje, Nova Varoġ and Priboj.

Figure 2: Wood processor plant's yard

In recent years, there has been consolidation of the wood processing sector in the region. Many smaller sawmills, higher up in the mountains have been closed. For instance, now all sawmills in Bajina Baġta towards Tara Mountain are within 10km distance from the city. Since the winters are sharp, and major mountains are situated across the region, many smaller sawmills cease their operations during the winter months, depending on the weather.

ñZelena Drinaò pellet producing company situated in Bajina Baġta, owned by the Italian Crabo SpA used to be the biggest wood processor in the region. However, it was shut down. This closure implicates both added room for the new/existing wood processors and growing trade misbalance between wood trade of Bajina Baġta area and other municipalities / regions. Namely, ñZelena Drinaòused to import bulk of its raw material from Eastern Serbia, and now far more wood is exported from e.g. National Park ñTaraò and surrounding area to far-away regions, while not much wood is imported.

SWOT analysis, in table below outlines Strengths, Weaknesses, Opportunities and Threats for the wood residuals production and availability on the market in Zlatiborski region.

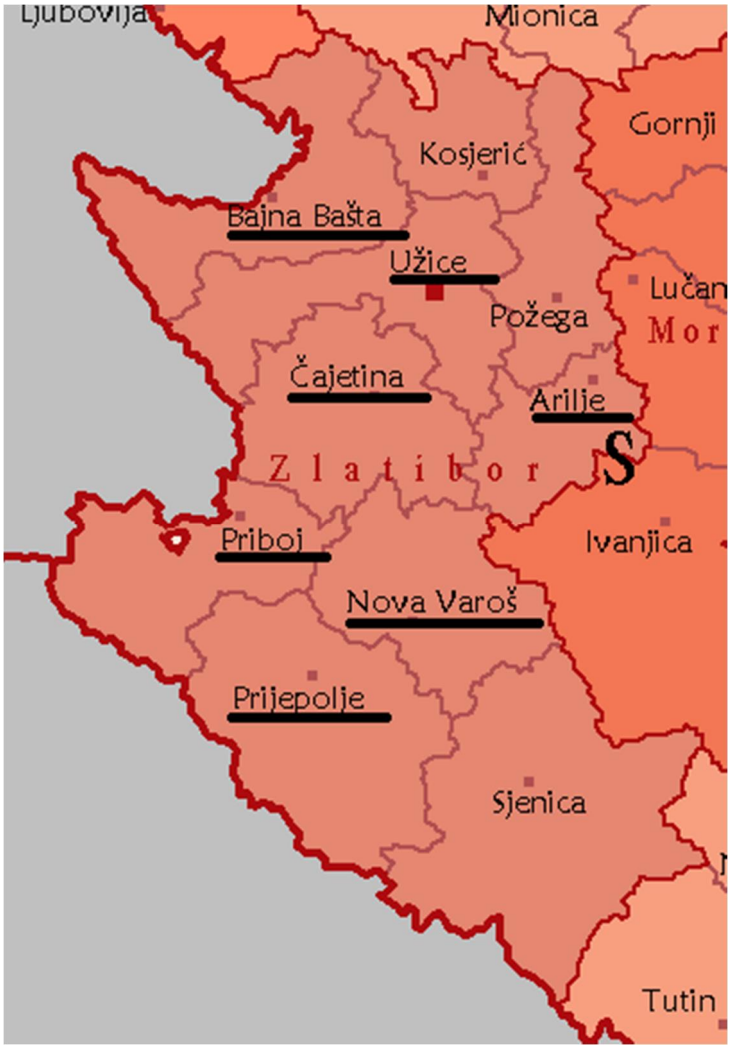
Table 2: SWOT Analysis

STRENGTHS	WEAKNESSES
▪ Abundance of forests and increasing biomass stock ▪ Sizable amounts of produced wood residuals. ▪ Wood processors also have transportation potential ï trucks and other vehicles are available ▪ Openness for expanding business ties on the side of wood processors ▪ Increasing cross- border wood trade with Bosnia & Herzegovina, Montenegro and Kosovo	▪ Hilly terrain and lack of infrastructure (access roads) in forests. ▪ Lack of access to finance ▪ Dependence on major raw material suppliers ▪ Seasonality of production, especially in higher mountain`s areas.
OPPORTUNITIES	**THREATS**
▪ Huge untapped potential especially in private forests. ▪ Local municipalities are conducting projects of fuel switch of district heating from fossil fuels to wood chips (Bajina Baġta, Nova Varoġ and Priboj) ▪ Joint approach to larger biomass customers, such as ñKronospan Serbiaò or District heating centers.	▪ Family-sized companies are often dependent on the personal fortunes of the single owner ▪ Disloyal competition from illegal loggers

1. Regional Overview and Data Analysis

Research of wood processing industry, focused on the supply side (production) of wood residuals in Zlatiborski Region has been conducted in the following municipalities: Bajina Bašta, Čajetina, City of Užice, Arilje, Nova Varoš, Prijepolje, and Priboj. This is highly forested region, as Table below shows.

Figure 3: Map of the Zlatibor Region, with underlined researched municipalities



Source: Wikimedia

Table 3: Forested areas – per municipality

Municipality	Forested area (ha)
Arilje	15.306
Bajina Baġta	30.073
Nova Varoġ	20.866
Priboj	33.581
Prijepolje	39.861
Uġice	28.239
Ų ajetina	23.866
TOTAL	191.792

Source: Statistic Bureau of Republic of Serbia

According to the official data of Statistic Bureau of Republic of Serbia, based on agricultural census, annual cuttings in Zlatibor region of hardwood are 148.217 m^3 and 136.874 m^3 of softwood. This provides both firewood for households, which is a priority, and raw material for wood processing industry.

National forests in Serbia are managed by state-owned companies ñSrbijaġumeò, ñVojvodinaġumeò and by National Parks. Around 50% of all forests in Serbia are private forests. This percentage is increasing due to the on-going restitution process. Forests in Zlatibor region are managed by two branches of ñSrbijaġumeò, based in Uġice and Prijepolje and by National Park ñTaraò, with headquarters in Bajina Baġta. Uġice branch of Srbijaġume covers municipalities of Arilje, Uġice, and Ų ajetina (as well as KosjeriĹ and Poġega), while the branch in Prijepolje covers municipalities of Nova Varoġ, Priboj, and Prijepolje.

The ñSrbijaġumeòforestry branch in Uġice manages state forests on territory of City of Uġice and municipalities of Ų ajetina, Arilje, Poġega and KosjeriĹ with covers 32.342,87 ha of forests, with total volume of 5.046.174,7 m^3 on average 156 m^3/hO. Annual increase of biomass volume is 121.920,50 m^3 on average 3,8 m^3/hO. This is excluding private forests. There are 60.665 ha of private forests on this territory, which makes around two thirds of all forests.

The Public Company National Park ñTarañ manages 12.300 ha of state forests on the territory of Bajina Baġta. Total volume of wood is 3.374.792 m³, average 260 m³/ha, with annual increase of 68.872 m³ or on average increase of 5,3 m³/ha. Reservation, where any exploitation is forbidden covers one third of the National Park. The National Park sells 45.000 m³ of all assortments of wood per year, out of which 90% stays in Bajina Baġta municipality. This wood volume consists 70% of softwood and 30% of hardwood. Softwood part consists of the following species: fir 60%, spruce 30% and pine 10%, while hardwood part is made of beech 80%, maple 10% and 10% other hardwood species. According to the cadaster there are 17.773 ha of private forests (including church forests). However, census of private forests, conducted by National Park ñTaraò on the territory of Bajina Baġta municipality has registered around 25.000 ha of private forests. The census was conducted in 2013. Because of the decreasing rural population, former fields and meadows have effectively turned into forests, while this was not accounted by updating cadaster register.

Table 4: Number of wood processing firms by size and municipality

MUNICIPALITY	NUMBER OF WOOD PROCESSORS (per annual log input m³)	
	Over 1,000	Below 1,000
Bajina Bašta	15	20
Čajetina	3	7
Užice	4	0
Arilje	8	6
Priboj	1	2
Prijepolje	13	1
Nova Varoš	9	5
TOTAL	**53**	**41**

The ñSrbijaġumeò forestry branch in Prijepolje manages state forests on the territory of municipalities Prijepolje, Priboj and Nova Varoġ, with total space of 54.434,87 hO, with wood volume of 8.020.945 m³, which is on average volume of 147,3 m³/hO with annual growth of

205.587 m³ or on average 3,8 m³/ha. There are 43,390 ha of private forests on this territory. Therefore, state owned forests are dominant on this territory.

In this research in Zlatiborski region, we interviewed 94 saw mills – see Table 4.
According to our research 233.392 m³ of raw material is being processed on average annually in the period 2013-2015 .

Table 5: Processed volume of wood by Wood Processing Industry – per Municipality in m³ on average in 2013-2015

Municipality	Average Raw Material Input (m³) 2013-2015
Bajina Bašta	69.692
Čajetina	15.992
Užice	12.990
Arilje	31.182
Priboj	3.043
Prijepolje	61.150
Nova Varoš	39.343
TOTAL	233.392

Out of the processed input, more than two thirds goes for fir and spruce, and four fifths is the pine is added. Hardwood makes close to 20% of the processed wood, with beech being predominant with its 17%. Around 1% of input has been wood from conflagration which affected the area in 2012 and ash wood. This is demonstrated in the Figure below and is presented in detail in the Table nr. 6.

Figure 4: Processed wood volume per specie

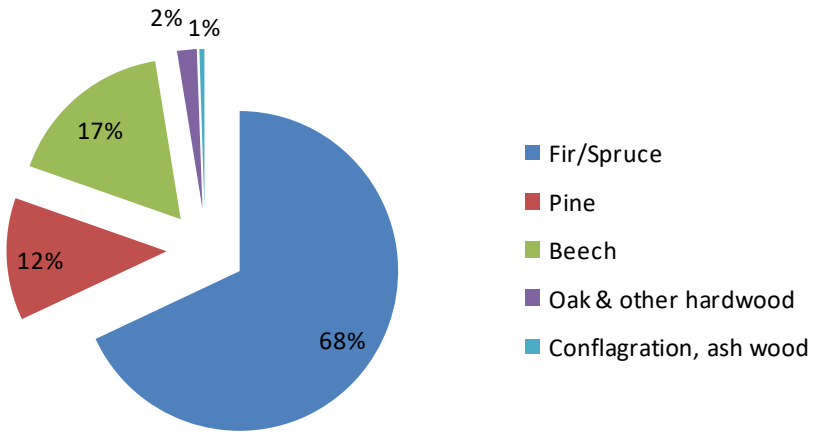


Table 6: Average Raw Material Input per municipality by major species 2013-2015

Municipality	Average Raw Material Input by major species 2013-2015					
	Fir/Spruce	Pine	Beech	Oak & other hardwood	Conflagration, ash wood	Total
Bajina Bašta	32.334	2.358	30.882	4.020	98	69.692
Čajetina	11.186	3.698	640	30	438	15.992
Užice	3.540	9.450	0	0	0	12.990
Arilje	21.565	3.990	4.962	665	0	31.182
Priboj	2.837	206	0	0	0	3.043
Prijepolje	54.934	5.491	0	0	724	61.149
Nova Varoš	32.247	3.677	3.418	0	0	39.342
Total	158.643	28.870	39.902	4.715	1.260	~233.390

With total raw material input of 233.392 $m_{ом}$ and with most companies having their yield around 70%; there have been in the period 2013-2015 on average produced 66.462 $rm_{ом}$ of wood residuals. We have identified wood residuals sold on the market by type, and we have also identified the quantity of internally used wood residuals. The sold and internally used quantities add up to make total quantity of residuals. The most available wood residuals on the market are slabs and sawdust as it can be seen in the Figure 5 and is shown in detail in Table 7.

Figure 5 Wood Residuals Availability in the Region

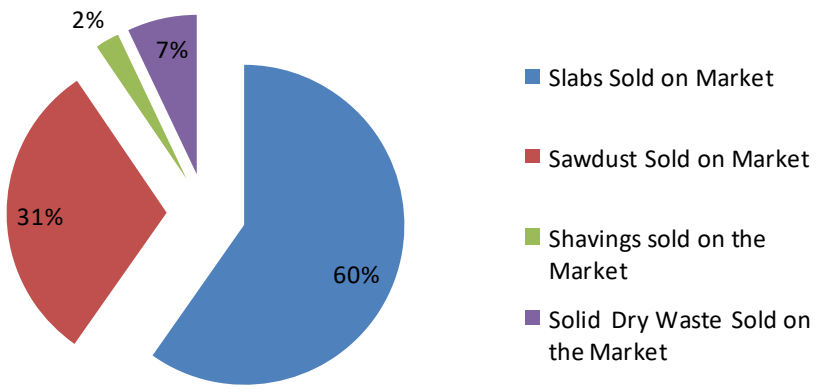


Table 7: Average Production of Wood Residuals 2013-2015 – by type

Municipality	Average Production of Wood Residuals 2013-2015					Total by municipality
	Slabs Sold on Market	Sawdust Sold on Market	Shavings sold on the Market	Solid Dry Waste Sold on the Market	Internal Use	
Bajina Bašta	7.897	3.667	476	362	6.102	18.504
Čajetina	1.369	628	0	0	2.811	4.808
Užice	1.605	1.348	0	1.143	0	4.096
Arilje	4.932	2.118	773	2.043	950	10.816
Priboj	735	182	0	0	0	917
Prijepolje	10.132	5.010	0	0	3.593	18.735
Nova Varoš	3.529	2.599	0	0	2.458	8.586
	30.199	15.552	1.249	3.548	15.914	Grand Total 66.462 rm/a

As already mentioned, taking into consideration geographic and therefore transportation consideration, number of wood processors and where they source their raw material, we have identified two different areas:

- Northern part, with wood processing plants concentrated around National Park ñTaraò and north of Zlatibor Municipalities of Bajina Baġta, Ļajetina, Arilje and City of Uġice belong here.
- Southern Part stretches along the border with Montenegro and south of Zlatibor including municipalities of Prijepolje, Nova Varoġ and Priboj.

Transportation considerations and other more details we will details taking this spatial fact into account.

2. Northern Part of Zlatiborski Region – Bajina Bašta, Čajetina, Užice and Arilje

The relief in Zlatiborski region is hilly and mountainous. However, regional roads are in good condition. Less so are the forest access roads, where the maintenance is often inadequate and where large portion of forests on difficult terrains is inaccessible.

The greatest distance in the region is between Bajina Baġta and Prijepolje, which is 117 km1.

City of Uġice is administrative center of Zlatiborski region and it is situated on the crossroads between other towns. Distances are not great, with distances in the Northern part not greater than 80 km between the towns, often less than 50 km. This satisfies the most economic sourcing expectations, which rely on 50 km fiber shred.

Table 8: Distances in the Užice region (km)

Municipalities	km
Uġice - Ļajetina	20
Uġice - Bajina Baġta	38
Uġice - Arilje	42
Bajina Baġta - Ļajetina	48

Source: Google Maps

The distance from Arilje to Bajina Baġta is 80 km and to Ļajetina is 62 km. However, Arilje together with Uġice has the best road network and is easily accessible. Bajina Baġta and Ļajetina lie in the immediate proximity of the resource (forests).

As it can be seen in Table 9, wood processors largely have their own trucks, with Bajina Baġta leading in transportation capabilities.

[1] According to Google Maps

Table 9: Transportation fleet – wood processors in Northern part of Zlatiborski region

Municipality	Nr. of trucks	Total tonnage
Bajina Baġta	26	421
Ļajetina	12	186
Uġice	6	144
Arilje	13	294
Total	57	1.045

While some wood processors in Uġice have closed their operation in the researched period, most of firms increased their production. Therefore, we can talk about some consolidation of the sector in this area. Most of processors are located in the western part of the municipality, closer to Ļajetina and Bajina Baġta then to Uġice. Closed 5 processors were processing around 3,500 m³/a, with around 65% of their raw material input coming from Bosnia.

Company ñGorġtakò from Ļajetina has been identified as the leading processor in the area. The company is located in Braneġko polje. This site has been identified as potential Biomass Logistic Wood Trade Center, since it already sells and produces most of the wood based fuel types, and it has good infrastructure. This plant is situated in intended industrial zone, with regional road access on the front side and railway access from the back side. Other infrastructure elements, such as strong capacity of supply of electrical power are in place as well.

Bajina Baġta is located between Drina riverbed and National Park Tara. This municipality is leading with quantity and quality of available forests, managed by both Srbijaġume and NP Tara. In the period covered by the research a few wood processing facilities have been close, most notably ñZelena Drinaò lumber and wood pellets producer, which was the biggest local producer with around 33-35.000 m³/a. This quantity was mostly brought from Eastern Serbia.

The ñMikro triò company used to have sawmill on the Bajina Baġta territory, however in the last years in Bajina Baġta there is left only panel and briquette production plant. This company sources wood elements from its own sawmill in Kraljevo, or buys them from other producers. Around 27.500 m³/a of beech ï timber is being processed. In addition, between 180 and 200 t/a of briquettes are produced.

Significant quantities of softwood from Bajina Baġta are sold to other municipalities of Zlatibor region, most often to Prijepolje and Ļajetina. Recently, ñKronospan Serbiaò from Lapovo has expanded its sourcing area to Bajina Baġta too. However, since ñStar Jelaò company from Prijepolje buys the biggest quantities of softwood celluloses, it was taken into account not to duplicate the amounts sourced within one municipality of the given region, and processed in the other municipality. ñStar Jelaò sources between 3.000-3.500 m^3 annually from the territory of Bajina Baġta municipality.

In Arilje and Bajina Baġta, due to many raspberry and blueberry producers, part of sawdust is sold for the purpose to fertilize the land ï so the soil gets the optimal acidity for the culture.

Another characteristic of the Northern part is that on average annually 700 m^3 of wood is collected at the PeruĆac lake dam, which was not taken into account by this study.

3. Southern Part of Zlatiborski Region– Prijepolje, Nova Varoš and Priboj

The relief in the southern part of the Zlatiborski region is also hilly and mountainous, and regional roads are in good condition. Forest infrastructure is similar to the northern part. Long borders from the west and south characterize this part of the region.

Three towns of Prijepolje, Priboj and Nova Varoġ are dispersed in three corners of a triangle. Distances are less than 50 km, which means that the sourcing of raw material can be very economic, given that the demand from wood residuals would be developed locally (DHCs, pellet or panel producers).

Table 10: Distances in Southern Part of the Zlatiborski region (km)

Municipalities	km
Nova Varoġ - Prijepolje	30
Nova Varoġ - Priboj	37
Priboj - Prijepolje	30

Source: Google Maps

Concerning the transportation fleet, Prijepolje has by far the most capabilities in the whole of Zlatiborski region. As it can be seen in Table 9, wood processors largely have their own trucks, with Bajina Baġta leading in transportation capabilities. Around half of trucks in Prijepolje come from ñStar Jelaò company. Nova Varoġ processors also have sizable fleet, while Priboj would have to both procure residuals and transport them in cooperation with processors in neighboring municipalities, in case that DHC or other consumer of wood residuals appear in Priboj.

Table 11: Transportation fleet – wood processors in Southern part of Zlatiborski region

Municipality	Nr. of trucks	Total tonnage
Priboj	1	24
Prijepolje	53	1.164
Nova Varoġ	26	604
Total	80	1.792

Another characteristics is that on the territory of Priboj municipality there are 15 unregistered sawmills. These sawmills work seasonally mainly to satisfy personal needs of their owners. All together they process estimated 300 m³ from private forests. During research period, 6 wood processors have ceased their operations.

Figure 6: Transportation fleet operated by local wood processors

Significant wood processor ñJela Star dooò is located in Prijepolje. This company is major producer of lumber, wood pellets (45.000 t/a) and wood chips (4.500 t/a). There are a few unregistered sawmills in Prijepolje too, which also work seasonally mainly to satisfy personal needs of their owners and source wood from private forests. Significant briquette producer ñBrikoòfrom Nova Varoġ has ceased the operations.

Annex 1: Survey Sheet

COMPANY AND CONTACT	_____		LOCATION	_____
NUMBER OF TRUCKS	_____	TOTAL TONNAGE		_____ t
TYPE OF PROCESS	_____			
SOURCE	SRBIJAĠUME	_____ %		
	NACIONALNI PARK TARA	_____ %		
	Privately owned forest	_____ %		
	IMPORT	_____ %		_____
		_____ %		_____
YIELD	FINAL PRODUCT	_____ %		
	SLABS	_____ %		
	SAWDUST	_____ %		
	SHAVINGS	_____ %		
	SOLID DRY WASTE	_____ %		
	INTERNAL USE	_____ %		
THE PRICE	SLABS	_____ EUR/M3		
	SAWDUST	_____ EUR/M3		
	SHAVINGS	_____ EUR/M3		
	SOLID DRY WASTE	_____ EUR/M3		

INPUT	2013	_____ M3	FIR/SPRUCE	_____ %	Type of Raw Material
	2014	_____ M3	PINE	_____ %	_____
	2015	_____ M3	BEECH	_____ %	_____
			OAK	_____ %	_____
			MAPLE	_____ %	_____
			WALNUT	_____ %	_____
			ASH WOOD	_____ %	_____
			Wood-conflagration 2012	_____ %	
			ACACIA	_____ %	